

bigger than the Falcons themselves, from the stomachs of the latter.

From what I have seen of these Falconets and their hunting, they seem to stoop at their prey on the wing, just as the larger Falcons do, striking it, when successful, with the hind claw, ripping the back open, and hurling it to the ground, where the slaughter is finished and the bird consumed as it lies. When, however, the bird is a very small one, such as a White-eye or a *Munia*, it is carried to the nearest tree to be eaten at leisure and in comfort.

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IV.—*Erythrism in Birds' Eggs*: an Address read at the Third Oological Dinner on 26 September, 1917, by E. C. STUART BAKER, M.B.O.U.

AMONGST the eggs I am exhibiting to-night there are perhaps very few that are startling either on account of their great rarity or exceptional coloration, but they serve to illustrate some remarks I would like to make on the subject generally of erythristic oology.

In the first place, it seems to me that the term erythrism has been too generally used, both by egg-collectors and oologists, as applying merely to abnormal red coloration in those eggs which normally show none. It should, however, be given a far wider interpretation than this, for it means, roughly speaking, the fact of being, or the act of becoming, red. If this is correct, then it follows that erythrism can be at once divided into two classes, normal and abnormal, and these again, especially the former, subdivided into many others.

As yet, so far as I know, normal erythrism in eggs has never been studied in connection with the classification of birds; yet it is possible that it may prove to be quite an important item amongst the many ways in which we egg-lovers believe that our particular branch may be of value. As regards abnormal erythrism, nothing further seems to

have been attempted beyond the exhibition of many most beautiful and extraordinary eggs.

In view, therefore, of the fact that the subject is so novel a one, my remarks must be held as purely suggestive of the lines upon which we might work in trying to ascertain what erythrism can teach us. It must also be remembered that erythrism, or its absence, is only one of many characters of each egg, and its value can only be estimated when considered in combination with the others.

Probably the first point which would strike any one on examining a really large collection of eggs is the extraordinary and erratic distribution of erythrism. In some cases it appears to be both constant and consistent throughout a whole order, family, genus, or species, whilst in others there appears to be no limit to its variation. The second point which would strike the systematist is that, as with birds themselves so with their eggs, a character of the greatest help in one family, genus or species is of no use whatever in another. But even with these two points conceded, it still appears to me that erythrism may be justly used as an aid in determining, or as a guide to the determination of, bird classification.

In the following remarks I propose to very briefly outline facts already ascertained, and a possible way in which these facts may be developed scientifically and some deductions drawn from them.

The simplest way will probably be to consider orders, families, genera, species and subspecies in the sequence as written, and to deal with normal erythrism first.

As regards orders, we find that there are some which normally contain no erythristic eggs, others which contain both erythristic and non-erythristic eggs, a few in which erythrism is the dominant colour, and still fewer in which all the individuals lay erythristic eggs. It is not easy, however, to think of any order in which there are not few or many exceptions to the general rule of erythrism, but, taken as a whole, the eggs of the Accipitres must be considered as forming a good

example. It is true that a considerable number of these birds lay white or nearly white eggs, and indeed in a few cases, such as *Astur*, *Butastur*, and *Accipiter*, in some eggs the blue of the hard inner shell shows through the outer layers of calcite, but in no case is the blue tinge strong enough to dominate the general tone. Whatever colour there is, with the exception of this blue tint, is of some erythristic shade, and it is important to remember that even the eggs of those Accipitres which generally lay white ones, often show spots and blotches of colour which invariably contain some degree of erythristic coloration. The primary or superficial markings may be brown with any degree of red in them, whilst the secondary or subordinate ones are of some shade of grey, neutral tint, or lavender equally invariably showing some slight trace of the same. The eggs of *Pernis*, *Tinnunculus*, and many species of *Falco* can only be described as red eggs, and undoubtedly such eggs preponderate greatly in this order.

Before leaving the subject of erythrism as applied to orders, attention should be drawn to that remarkable group, the *Phaethontideæ*, generally placed with the Steganopodes, but probably worthy of being raised to an order by themselves. The eggs of these, even more consistently erythristic than those of the Raptores, show remarkable affinities to the eggs of this order, as indeed do the birds themselves in many respects.

Amongst families it is a much easier matter to find examples in which all the species invariably lay erythristic eggs. There are many such, but there are two which to me, as a collector of Indian eggs, appear particularly striking, *i. e.*, the *Dicruridæ* and *Brachypodinae*. The latter family—or subfamily as Oates calls it—has no member which does not lay truly erythristic eggs, and any field-naturalist can say, almost at a glance, whether an egg does or does not belong to it. To-night I have had to place a limit on my exhibition, space and the difficulty of carriage necessitating this, but in the one box shown there are examples of ten

genera and forty species of Indian Bulbuls, and those who know the African species will see that many of them could be duplicated by these and even substituted for them without fear of detection.

Sharpe, in his Hand-list, includes Oates's *Brachypodina* in the *Pycnonotidæ* together with the genera *Ægithina*, *Æthorhynchus*, *Chloropsis*, and *Irena*. The eggs of these four genera would at once lead us to infer that they belong to quite different groups, and a careful study of the birds, to my mind, confirms what the eggs first tell us. *Irena* is probably a Thrush, to be placed somewhere near the genus *Cochoa*, whilst the other three genera must be placed with other Timeleine forms or else constitute a group by themselves.

Next to families and subfamilies, and before dealing with single genera, it is necessary to consider certain groups of genera which cannot be excluded from families containing many others, yet which are remarkable for the close resemblance between their eggs, shown, in so far as we are concerned this evening, by their erythrism. For this purpose I show three small boxes containing eggs of the Sylviine genera *Urosphena*, *Horeites*, *Neornis*, *Horornis*, and *Cettia*. So closely are these allied that many naturalists have merged two or more of them into one. This combination of the genera seems to be sound the more we study the birds, and the wonderful erythristic character of the eggs would certainly seem to endorse it.

After groups of genera we naturally come to isolated genera, all the species of which show erythrism well defined though varying somewhat in degree. Such genera are exemplified to-night by *Chloropsis*, *Pyctorhis*, and *Piprisoma*, each with several species, but such examples may be added to almost *ad infinitum*.

To generic erythrism naturally succeeds specific erythrism, and we find that many genera contain species some of which lay erythristic eggs, whilst others lay eggs in which there is no trace of red. To such genera belong the species

*Pellorneum ignotum*, *Prinia socialis*, and *Ruticilla frontalis*, which all lay truly erythristic eggs, whereas the majority of the remaining species of the same genera lay eggs of quite different coloration. To show the contrast, the erythristic and non-erythristic eggs are shown together.

Finally, normal erythristism may be shown in the eggs of one subspecies of a species, all the rest of which show none. This is, I think, a rare form of erythristism, but occurs now and then. The exhibit shown is a very beautiful example, the eggs of *Prinia inornata blanfordi* being fine red eggs, whilst *P. i. inornata*, *P. i. extensicauda*, *P. i. burmanica*, and *P. i. jerdoni* all lay equally beautiful, but bright blue, eggs.

The above embraces examples of the facts which are already known to all oologists, though perhaps they have not yet been enumerated in a similar manner; when we advance beyond these facts we seem at once to enter the second class, that of abnormal erythristism. Here, however, we enter so wide a field that I have really not attempted to show anything beyond a couple of species, *Corvus splendens* and *Timelia pileata*, in which erythristism is very rare, and two other species, *Dendrocitta rufa* and *Orthotomus atrigularis*, in which it is so common that it becomes an almost normal phase of coloration. Exceptionally rare and beautiful examples of erythristism are being shown by many of our members to-night, and will more than serve as illustrations of abnormal coloration.

From the remarks I have made and the exhibits shown, I hope some deductions may be drawn. Thus it may suffice to maintain that if coloration and other characteristics of eggs form any guide to systematic classification, erythristism, or its absence, should be one type of coloration worthy of careful consideration. As regards families, it shows that a non-erythristic egg cannot belong to any bird which should be placed amongst the Bulbuls. Again, no non-erythristic egg can be laid by any bird entitled to a place in the *Tribura* group of genera. Lower down the grades we find that, whereas all the other known species and subspecies of



*Pellorneum* lay non-erythristic eggs, *Pellorneum ignotum* and its subspecies lay quite red eggs. So true is this that I may point out that *P. i. cinnamomeum* until very recently was placed in another genus, *Drymocapthus*, and it was a knowledge of its curiously erythristic eggs which enabled me to show Col. H. Harington where it should be placed.

From the *Prinia inornata* exhibit quite a different line of reasoning may be worked out, and possibly we are here given a clue to one of the causes of erythrism. The breeding-ground of *Prinia*, generally speaking, is dry grass or scrub-covered land, or mixed low bush and grass country, free from water and above flood-level. *P. i. blanfordi*, however, which lays the red eggs, is to be found breeding almost invariably in heavy grass in marshes, swamps, or flooded land. Is there any connection between erythrism and humidity?

So far my exhibit has dealt with forms of erythrism for which we can advance no reason or cause, or, as in the last case, can offer mere conjecture or suggest a line for further research. Erythrism can, however, be carried somewhat further than this, for there is a form of it which we can explain as the direct result of evolution with a definite cause. My last and most interesting exhibit gives examples of this.

First, the large eggs shown at the top of the box consist of two clutches of eggs of the Yellow-wattled Plover, *Sarciophorus malabaricus*; one of these is normal, the second a very beautiful type of erythrism. In this particular instance there are good reasons for the evolution of a red egg, and consequently it is not confined to a single odd clutch here and there, but is found in very numerous instances within a certain area. The probable solution of this case is due to the researches of Mr. J. Stuart of Travancore, who has spent much time and labour in its elucidation. It appears that in the south-west of India, near the coast of Travancore, there is a belt of country where this Plover is resident in considerable numbers, augmented in the breeding-season by a good many more

which are locally migratory, moving up and down the coast as food and other conditions exert their influence upon them. Now a certain portion of this breeding-ground consists of a dry red laterite, and over this area a large proportion of the eggs found are red also. Our conclusions are that the red eggs are laid by the resident birds and the others by the visitors. It would seem that through the countless generations of Plover which have habitually bred on this red soil, a certain number in each generation have laid eggs more inclined to be erythristic than the others, and such eggs assimilating with the ground better than the ordinarily coloured ones have escaped destruction by vermin in greater degree than the latter. In each generation the erythristism has been emphasized by selection until the present wonderful stage of adaptation has been reached. That it is not casual erythristism is shown by the fact that in one breeding-season Mr. Stuart and his collectors found—I do not say took—over seventy of these wonderful eggs.

Even admitting this reason for the evolution of the red *Sarciophorus* egg, we are still only in the first stage of investigation and suggestion, for we have also found that the Red-wattled Lapwing, *Sarcogrammus indicus*, which breeds freely on the same ground, has made no advance in the evolution of a red egg. Why should this be?

The other two groups of eggs shown are similar types of evolution, though in their cases the immediate need for erythristism has been different. They are both Cuckoos' eggs in which erythristism has been evolved, not for their protection against destruction by vermin, but for the purpose of deceiving certain selected fosterers into undertaking their incubation.

The central set of eggs belong to the small Indian Cuckoo, *Cuculus intermedius*, and by this bird we find that two, and only two, very strongly contrasting types of egg are laid—the one pure white, and the other some shade of terra-cotta or chocolate. It is interesting to observe that, though some 150 eggs of this little Cuckoo have passed through my

hands, I have never seen an egg intermediate in colour between the two types—a fact which shows that evolution has advanced practically to completion. The white eggs are, of course, deposited in the nests of birds which lay white eggs or eggs which are not too vividly spotted upon a white ground, such as the *Phylloscopi* and *Acanthopneuste*; the red eggs, on the other hand, are placed in the nests of such birds as *Horornis*, *Cettia*, *Oligura*, *Tesia*, etc., which lay eggs very similar in colour. Over the greater part of its range both types of eggs of this Cuckoo may be found, for suitable fosterers also occur everywhere therein; but in some places one type will preponderate greatly over the other, according as the white-egg or the red-egg fosterer is the more numerous. In Japan, however, so far as I am aware, the terra-cotta type of egg is the only one ever laid, and that is simply because the *Cettia*, in whose nest it is placed, is so common and has proved so good a fosterer that it has not been necessary to select any other, and the Cuckoo practically invariably places her egg in that bird's nest.

The last group contains eggs of the Indian Plaintive Cuckoo, *Cacomantis passerinus*. This Cuckoo, over nearly the whole of the area in which it breeds, lays eggs which are either a pale blue or white, faintly and sparsely marked with reddish; these are deposited in the nests of *Orthotomus sutorius*, *Cisticola*, *Suya*, or some other small Warblers with whose eggs they agree very well. In the Deccan, however, the most common Warbler is *Prinia socialis*, the Ashy Wren-Warbler, and this has accordingly been selected by the Cuckoo as the most suitable nurse for its young. But this Warbler lays red eggs, with which the great majority of Cuckoos' eggs would contrast most conspicuously; in consequence, therefore, a red egg has also been gradually evolved for the Cuckoo by the foster-parents in each generation destroying those which were most unlike their own, until a red stage has been arrived at sufficient to deceive the Warblers and ensure the perpetuation of the Cuckoos.